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OPTIMIZATION OF WOVEN FABRIC PRODUCTION IN TEXTILE INDUSTRY OF PT. ARGO PANTES TANGERANG

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ABSTRACT

Corporate performance is measurable by its activities of which is supported by the industrial performance through the Optimization in targeted profit. PT. Argo Pantes is a manufacturing company which processes yarn and woven fabric. In the daily process the company has many problems or constrains in production planning. Uncertaintly demand of goods fluctuation has effect on shortage or Surplus production. Others problems are raw materials, machine work hour, labour work hour, spindle hour per unit, Loom hour per unit, and the demand of the products. The objective of this research is to maximize a business profit by using the application of linear programming. Simplex method of Linear programming purposes to maximize profit in linear function. Profit (Z) = 20 X_1 + 15 X_2 and linear function of the two constrains, Spindle hour per unit: 100 X_1 + 50. $X_2 \leq 1000$ and Loom hour per unit: 20 X_1 5 $X_2 \leq 300$. The Total profit earned by PT. Argo Pantes at Tangerang to produce a T/C woven fabric is \$133.400, and for cotton 100% woven fabric is \$100.050 with the assumtion of profit is in accordance with fixed objective and constrain function.

INTRODUCTION

Textile and Textile Products (TPT) in the textile industry in Banten province is one of the country's sources of foreign exchange, also an industry that can accommodate a large number of workers. In 2,000 the number of laborers working in that sector amounted to almost 1.2 million people spread over 2,651 textile industry companies in Indonesia. West Java Province is the largest place of textile industry, which is 1.496 pieces (56.43%) followed by DKI Jakarta 456 units (17.30%) and Central Java 381 (13.37%). The rest is spread in Sumatra, D.I. Yogyakarta, East Java, Bali and Sulawesi.

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One of the problems arising with the existence of textile and textile products (TPT) is the impact of scientific and technological advances that lead to increased competitiveness among producers, both in the domestic market and overseas markets.

One of the most popular scientific advancements up to now is linear programming that its application can also be done on textile industry in PT. Argo Pantes Tangerang. The use of linear programming is to optimize the production of woven fabric in order to obtain maximum business profit. In a case study in the textile industry environment of PT. Argo Pantes this writer will try to apply linear programming through simplex model in order to optimize woven fabric production with the aim to achieve maximum business profit.

PROBLEM AND EQUATIONS IN LINEAR PROGRAMMING

Linear programming was developed for the first time by G.B. Dantzig in 1951. Linear programming is a problem-solving method that deals with the use of multiple resources / commodities to produce multiple products. In addition, each unit (unit) of each product produced can provide a benefit. By utilizing linear algebraic theories, several techniques or procedures can be developed so that without having to re-explore the theories, techniques or the procedure can be used to formulate or find solutions to problems that involve the combination of resources and products mentioned above. In this way, the maximum benefit to be gained can be determined.

In the field of textile industry, the use of linear programming method can be widely applied. Some of these are used to analyze plant operations, production planning, fiber mixing in the spinning process, sales production coordination, marketing strategy, research activities and so on.

Through this paper will be described the concept of linear programming briefly and its application in order to optimize the production of woven fabric in the company of PT. Argo Pantes. The formulation of liniear programming problem can be arranged in the form of the following mathematical model. If the factory will produce F_1 type of fabric products as much as X_1 units and F_2 as much as X_2 units, then the benefits that can be obtained are:

$Z = C_1 X_1 + C_2 X_2 + ... + C_nX_n$ .... (1)

Equation (1) as above is called an objective function. Furthermore to make F_1 fabric as much as X_1 unit required $a_{11} X_1$ hour-spindle and $a_{21} X_1$ clock-loom. As for making F_2 fabrics as much as X_2 units required $a_{12} X_2$ hour-spindle and $a_{22} X_2$ hour-loom. So to make two kinds of fabric needed each:

- **Spindle – Hour as:** $a_{11} X_1 + a_{12} X_2$ and
- **Loom – Hour as:** $a_{21} X_1 + a_{22} X_2$

Since the hour capacity - the available spindle is b_1 and the hour capacity - Loom is b_2 then the use of the spindle - hour number and hour - the loom should not exceed the available capacity so that

- $a_{11} X_1 + a_{12} X_2 \leq b_1$ .... (2)
- $a_{21} X_1 + a_{22} X_2 \leq b_2$ .... (3)

Equations (2) and (3) are called the constraint function For more details the above issues can be illustrated as table 1 below:

Table – 1: *Linear Programming Problems for Two Types of Products*

Resources	T/C Woven Fabric F_1	Product Cloth F_2	Available Capacity
Cloth Production (unit)	X_1	X_2	
Spindle Hour per Unit	a_{11}	a_{12}	b_1
Loom Hour per Unit	a_{21}	a_{22}	b_2
Profit per Unit ($)	C_1	C_2	

Based on the problems listed in table 1 then the formulation of the problem can be arranged as follows:

Maximize: $Z = C_1 X_1 + C_2 X_2$ .... (4)

Limiting Function: $a_{11} X_1 + a_{12} X_2 \leq b_1$ .. ..(5)

$a_{21} X_1 + a_{22}X_2 \leq b_2$ .... (6)

$X_1, X_2 \geq 0$ .... (7)

The main purpose with the formulation of the problem or problem mentioned above is to determine the prices $X_1, X_2,$ .... X_n While a_{ij}, b_i, and C_j are constants respectively.

PROBLEM SOLVING METHOD

To solve problems or problems with Linear Programming many methods have been developed. One of them is quite popular is the simplex method. Solving the problem with the simplex method in principle is to use simple formulas by means of iteration (repetition / replication steps) using matrix tables so that the results can be maximally achieved in stages.

THE OPTIMIZATION OF PRODUCTION BY LINEAR PROGRAMMING

At present the textile industry company PT. Argo Pantes makes two kinds of T / C woven fabrics and 100% Cotton woven fabrics These two types of products can each provide a net profit of $20 and $15 per unit. The number of spindle clock per unit (in spinning process) to make cotton tetoron (T / C) product is 100 and 100% cotton fabric is 50. While the number of hours - loom per unit the T / C fabric product is 20 and the cotton fabric 100% is 25. In addition, the survey results show that the total capacity available in the plant is 1000 and the total capacity of the clock - loom is 300. Based on the data can be determined the optimum combination number of fabrics to be produced by textile factory of PT. Argo Pantes through the table 2 Linear Programming below.

Table – 2: *Data for the Problem Solving by Linear Programming*

Product / Resources	Woven Fabric T/C	Woven Fabric Cotton	Capacity
Spindle Hour per Unit	100	50	1.000
Loom Hour per Unit	20	25	300
Profit per Unit ($)	20	15	

Data to determine the optimum combination of 100% T / C and Cotton woven fabrics to be produced by PT. Argo Pantes listed in Table 2, the problem can be formulated as follows:

Maximize: $Z = 20 X_1 + 15 X_2$ .... (8)

Constrain Function: $100 X_1 + 50 X_2 \leq 1000$ .... (9)

$20 X_1 + 25 X_2 \leq 300$ .... (10)

4.1 Optimization by Using Simplex Method

The limiting function in the formulation of the above problem contains a sign of inequality, for it must first be changed into the form of equation by adding "slack variable" X_3 and X_4 so that the formulation of the problem becomes :

$Z - 20 X_1 - 15 X_2 = 0$ .... (11)

$100 X_1 + 50 X_2 + X_3 = 1000$ .... (12)

$20 X_1 + 25 X_2 + X_4 = 300$ .... (13)

The next step, the formulation of the problems that have been prepared as in equations (11), (12) and (13) done with simplex algorithm as follows:

Step 1

Make table 3 below and the contents of the X and Z coefficients of the Limiting functions and Objective functions

Table – 3: *Solutions with Simplex Method in Early Conditions*

			1	2	3	4	0
No.	Base Variable	Z	X_1	X_2	X_3	X_4	RK
0	Z	1	-20	-15	0	0	0
1	X_3	0	100	50	1	0	1000
2	X_4	0	20	25	0	1	300

Variables X_3 and X_4 are slack variables of the initial conditions also functions as a base variable. While X_1 and X_2 are called non-base variables.

Step 2

At row (0) select the cell that has the lowest negative price. This price is obtained on line (0) and column (1) or on cell (01). Since the price is obtained in column (1) then F = 1, In F = 1 is the column for the variable X_1 so X_1 is the new base variable candidate (will enter the base variable).

Step 3

Consider the RK column or column (0) of the newly selected column (1), then choose the smallest positive price of the price comparison in column (0) divided by the price in column (1), the result of this comparison is as follows:

Line (1): 1000 / 100 = 10

Line (2): 300 / 20 = 15

Nilai terkecil diperoleh pada baris (1), jadi r =1 pada baris r = 1 ini merupakan baris pada X_3 sehingga X_3 harus meninggalkan baris.

The smallest value is in line (1), so r = 1 in line
r = 1 is a line in X_3 so X_3 must leave the line.

Step 4

For row (1) or r = 1 the price - the cell price becomes as follows:
Column (1): $a_{11} = 100$, $a_{rk} = a_{11} = 100$, and then $a_{11} = 100/ 100 = 1$ as a new value
Column (2): $a_{12} = 50$ $a_{12}' = 50 / 100 = ½$
Column (3): $a_{13} = 1$ $a'_{13} = 1/ 100$
Column (4): $a_{14} = 0$ $a'_{14} = 0 / 100 = 0$
Column (0): $a_{10} = 1000$, and then $a'_{10} = 1000$ devided 100 or (1000 / 100) = 10

For the other rows of rows (0) and row (2), each obtained in the following way:
For line (0)
Column (1): $a_{01} = –20 a_{11} = 1$ $a_{01} = 0$
Column (2): $a_{02} = –15 a_{01} = –20$ $a_{12}' = ½$ maka $a'_{02} = –5$

In the same way as above then
Column (3): $a'_{03} = 0 – (1/100) (–20) = 1/5$
Column (4): $a'_{04} = 0$
Column (5): $a'_{00} = 200$

For Line (2)
Column (1): $a'_{21} = 20 – 1(20) = 0$
Column (2): $a'_{22} = 15$
Column (3): $a'_{23} = –1/5$
Column (4): $a'_{24} = 1$
Column (0): $a'_{20} = 300 – (10)(20) = 100$

Furthermore the contents of cells in rows (0) and row (2) with new values have been calculated above and the results are as listed in Table 5 below:

Table – 4: *Solutions with Simplex Method in the First Iteration*

			1	2	3	4	0
No.	Base Variable	Z	X_1	X_2	X_3	X_4	RK
0	Z	1	0	-5	1/5	0	200
1	X_1	0	1	½	1/100	0	10
2	X_4	0	0	15	-1/5	1	100

The results of the table above show that on line (0) still looks negative cell value, so the next calculation is back to Step 2.

Step 2

The smallest negative value in row (0) is at value on cell (02) so F = 2. This means that X_2 will enter the row variable.

Step 3

The comparison of cells in column (0) with column (2) yields the smallest ratio in cell 22 or to line (2) so r = 2 Thus the variable X_4 is the variable leaving the base.

Step 4

The new tables obtained are as listed in Table 5 below:

Table – 5: *Solutions with Simplex Method on Second Iteration*

			1	2	3	4	0
No.	Base Variable	Z	X_1	X_2	X_3	X_4	RK
0	Z	1	0	0	2/15	1/3	233,33
1	X_1	0	1	0	1/60	-1/30	6,67
2	X_2	0	0	1	-1/75	1/15	6,67

Note: volume in unit x 1000

Step 2

Based on Table 5, it appears that row (0) no longer has a negative cell value, so the next step is to proceed to step 5

Step 5

The optimum result is the production of T / C woven fabric of 6.670 units (cell contents 10) and 100% Cotton Woven Fabrics is 6.670 units listed in the table (content of cell 20). Maximum Business Profit or Profit ear ned is $233,330,

CONCLUSIONS

Conclusion can be drawn from Table 5 Linear Programming Solution with Simplex Method that:

1. The production of polyester cotton (T / C) mixed woven fabrics reaches an optimum of 6.670 Units
2. Production of woven fabric for 100% Cotton type reaches an optimum of 6.670 units.
3. Maximum profit or business profit can be achieved for $233,330.

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